1990 AIR QUALITY DATA SUMMARY

REGIONAL MUNICIPALITY OF WATERLOO AND

THE COUNTIES OF WELLINGTON AND BRANT

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1990 AIR QUALITY DATA SUMMARY REGIONAL MUNICIPALITY OF WATERLOO AND THE COUNTIES OF WELLINGTON AND BRANT

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OCTOBER 1992

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INTRODUCTION

This report summarizes the results of air monitoring in the Regional Municipality of Waterloo, and the Counties of Wellington and Brant in 1990.

The Ministry of the Environment's West Central Region has conducted monitoring in the area since the early 1970's. The Air Management Program in Ontario is based on controlling man-made emissions to meet ambient air quality objectives, which in turn are based on known effects on health, quality of life or sensitive vegetation, whichever is most stringent. To achieve these objectives, sources of pollution are identified, their emissions evaluated and appropriate control measures are instituted. Ambient air monitoring is used to identify pollution sources, evaluate the need for controls and then determine whether controls have been successful.

In addition to monitoring specific industrial sources, monitoring of a more general nature is also carried out in various localities to determine if air quality objectives are being met and to observe trends in air pollution.

In June, 1988, the Ministry commenced broadcasting the new Air Quality Index across the Province at over 30 locations, including Guelph, Kitchener and Waterloo. A description of the AQI and the 1990 results appear in this report.

MONITORING NETWORK

The Ministry of the Environment's West Central Region operated a network of monitors in Ayr, Brantford, Fergus, Guelph, Kitchener and Waterloo. Some of the monitoring was performed near industrial sources, in many cases, as a response to local complaints. Monitoring of a more general nature was also carried out at single stations in Guelph, Kitchener and Waterloo to characterize air quality in larger population centres and to measure the Air Quality Index.

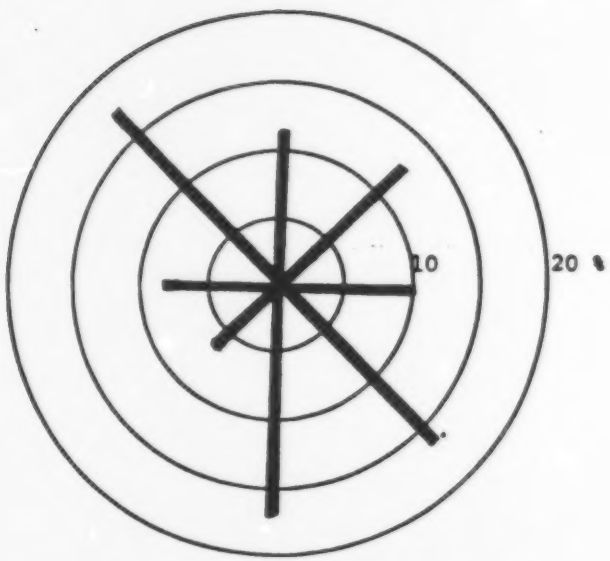
Meteorological data (wind and temperature) are not measured by the Ministry in the area. However, data measured by Environment Canada at the Kitchener/Waterloo Airport is provided to the Ministry for data analysis. The Ministry installed its own wind tower equipment in Cambridge in 1991. Figure 1 illustrates the typical wind frequency distribution for the area and shows that winds from the southeast, south and northwest quadrants predominate almost 50% of the time. Consequently, wherever possible, stations are located downwind of suspected pollution sources with respect to these winds.

FIGURE 1
WIND FREQUENCY DISTRIBUTION

ELORA RESEARCH STATION

BY UNIV. OF GUELPH

1988



Lines indicate direction from which wind blew

POLLUTANTS MONITORED

Two basic types of air pollutants are measured - gases and particulates (dust).

a) Gases measured with continuous analyzers include:

Sulphur Dioxide (SO_2) - monitored in Guelph, Kitchener and Waterloo for general ambient levels. SO_2 is a product of fuel combustion. Air quality objectives and their limiting factors are:

1-hour average - .25 ppm (vegetation effects)
24-hour average - .10 ppm (health effects in conjunction with particulates)
1-year average - .02 ppm (vegetation effects)

Carbon-Monoxide-(CO) - general ambient levels are measured in Kitchener. The major source of CO is the automobile. Objectives for CO are:

1-hour average - 30 ppm (health effects)
8-hour average - 13 ppm (health effects)

Ozone (O_3) - measured in Kitchener, Waterloo and Guelph to check general ambient levels. Oxidants are products of photochemical reactions involving oxides of nitrogen, hydrocarbons and sunlight. Ozone accounts for most of the oxidants produced. The sources of the precursor pollutants are mainly industrial and automotive. Concentrations follow very definite annual trends with highest levels occurring during the summer, and daily trends with highest levels occurring in mid-afternoon. Both patterns are directly related to temperature and the amount and intensity of sunlight. Ozone and its precursors can be transported over great distance and can be augmented by local sources. Most of

the high levels in Southern Ontario each summer arrive from the United States. An objective for ozone is:

1-hour average - 80 ppb (vegetation effects)

Oxides of Nitrogen - general ambient levels were measured in Kitchener. They are a product of high temperature combustion sources including the automobile. The most abundant oxides are nitric oxide (NO) and nitrogen dioxide (NO_2). Objectives exist only for NO_2:

1-hour average - .20 ppm (odour)
24-hour average - .10 ppm (health effects)

b) Particulates (dust) were measured by three methods, each relating to a different size range of particles.

Dustfall - heavy visible material generally greater than 10 microns in size (one micron is one-millionth of a metre) that settles out of the atmosphere due to gravity. A plastic container is exposed for one month and the collected dust is weighed and expressed as a deposition rate of grams/square metre/30 days. The measurement is imprecise and observations are restricted to relatively local areas. However it is a practical method of measuring the visible dust which often causes complaints. Criteria are:

1-month average - 7.0 g/m^2/30 days (nuisance effects)
1-year average - 4.5 g/m^2/30 days (nuisance effects)

Total Suspended Particulates (TSP) - measured with high volume (hi-vol) samplers near industrial sources and for general ambient observations. The particles range from submicron to about 50 microns in size. The hi-vol sampler draws air through a glass fibre filter for a 24-hour period. The exposed filter is weighed and the weight of the solids

collected is converted to an equivalent concentration in air expressed in micrograms per cubic metre. The samplers run once every six days. Criteria based on visibility effects are:

24-hour average - 120 ug/m^3 (health effects)
1 year geometric mean - 60 ug/m^3 (health effects)

Soiling Index (Coefficient of Haze) - general ambient levels were measured in Kitchener, Waterloo and Guelph by tape samplers which measure fine particles less than 10 microns. Coefficient of haze tape samplers determine hourly soiling values. Air is drawn through a filter paper tape for one hour. A beam of light is shone through the paper before and after the airborne particles are collected. The difference in light transmission is translated into a coefficient of haze (COH) unit. The paper tape then advances and a new hourly sample is collected. The criteria shown below are based largely on correlations with total suspended particulate (TSP).

24-hour average - 1.0 COH's/1000 linear feet of air
1-year average - .5 COH's/1000 linear feet of air

c) Air Pollution Index (API) - the API has been measured since 1970 but is now incorporated as a subindex of the new air Quality Index (AQI). It is derived from 24-hour average concentrations of sulphur dioxide and soiling index, based on the following equations:

Kitchener, Waterloo and Guelph

$$API = 3.33\ (9.1\ COH + 120.8\ SO_2)^{.74}$$

where:
COH is the 24-hour average soiling index concentration

expressed in coefficient of haze units.

SO_2 is the 24-hour average concentration of sulphur dioxide expressed in parts per million.

Air Quality Index (AQI) - the AQI is a more comprehensive information system by which the public can be informed about air quality on a daily and even hourly basis. The index replaced the API (described above) which had been in place since 1970. The API still exists as a subindex of the AQI. In the AQI, hourly concentrations of sulphur dioxide, soiling index (particles), nitrogen dioxide, carbon monoxide, ozone and reduced sulphur compounds are all converted to a common scale of numbers. In addition to these hourly measurements, 8-hour average levels of carbon monoxide and the API, a function of sulphur dioxide and particles are also included as subindices, making a total of 8 potential subindices measured every hour. The official AQI broadcast is the highest subindex at that time.

The AQI scale is classified as follows:

0 - 15	Very Good
16 - 31	Good
32 - 49	Moderate
50 - 99	Poor
100+	Very Poor

Index levels up to 31 should have little or no effect on people and the environment. Beginning at the moderate level, effects such as odour, vegetation damage and some health effects to sensitive individuals start to occur.

In the poor and very poor categories, these symptoms become more and more acute, such that virtually all people would be hampered in the very poor range.

When moderate levels or higher are measured, public health advisories can be issued to the public along with the actual index number.

The AQI started in June 1988, and annual 1990 statistics on hourly frequencies in the five concentration categories for nine West Central Region stations are presented in Table 1.

As can be seen, ozone (O_3) was generally the most problematic pollutant across the region. This pollutant and others in the AQI will be discussed in more detail in this report.

TABLE 1

AIR QUALITY INDEX - 1990

HOURLY FREQUENCY DISTRIBUTION

STATION/ LOCATION	POLLUTANT	HOURS 0-15 VERY GOOD	HOURS 16-31 GOOD	HOURS 32-49 MODERATE	HOURS 50-99 POOR	HOURS 100 + VERY POOR
26029/60	SO_2	8137	0	0	0	0
	COH	3855	42	0	0	0
	O_3	8067	505	35	0	0
KITCHENER	NO_2	8497	0	0	0	0
	CO 1hr	7270	0	0	0	0
	CO 8hr	7270	0	0	0	0
	API	3703	1	0	0	0
26045	SO_2	8674	0	0	0	0
	COH	8460	42	2	0	0
WATERLOO	O_3	8081	375	4	0	0
	API	8429	54	0	0	0
28028	SO_2	8625	0	0	0	0
	COH	8319	26	0	0	0
GUELPH	O_3	7526	575	52	0	0
	API	8459	0	0	0	0
27067	SO_2	8668	0	0	0	0
	COH	8115	85	9	0	0
	O_3	6509	632	44	0	0
ST.	NO_2	8478	0	0	0	0
CATHARINES	CO 1hr	8659	0	0	0	0
	CO 8hr	8659	0	0	0	0
	API	8156	11	0	0	0
27056	SO_2	8694	0	0	0	0
	COH	8644	29	2	0	0
NIAGARA	O_3	7790	812	93	0	0
FALLS	API	8666	20	0	0	0

TABLE 1, cont.:

STATION/ LOCATION	POLLUTANT	HOURS 0-15 VERY GOOD	HOURS 16-31 GOOD	HOURS 32-49 MODERATE	HOURS 50-99 POOR	HOURS 100 + VERY POOR
29000	SO_2	8666	0	0	0	0
	COH	8138	433	72	1	0
	O_3	8176	382	19	0	0
HAMILTON	NO_2	8634	0	0	0	0
DOWNTOWN	CO 1hr	8560	0	0	0	0
	CO 8hr	8560	0	0	0	0
	TRS	8401	126	28	0	0
	API	7272	1034	55	0	0
29105	SO_2	8608	0	0	0	0
	COH	8358	217	18	0	0
HAMILTON	O_3	8168	480	33	0	0
EAST	API	8242	267	0	0	0
29114	SO_2	8685	0	0	0	0
	COH	8426	176	28	0	0
HAMILTON	O_3	8025	617	61	0	0
MOUNTAIN	NO_2	8529	0	0	0	0
	TRS	7990	87	24	0	0
	API	8258	318	14	0	0
29118	SO_2	8716	0	0	0	0
	COH	7962	478	60	0	0
HAMILTON	O_3	8172	434	41	0	0
WEST	NO_2	8579	0	0	0	0
	TRS	8374	138	16	0	0
	API	7724	877	7	0	0

DATA ANALYSIS

Ayr

Dustfall has been measured at station 26026 - Stanley St. near the Date Industries Foundry since 1976 (Figure 2).

In April 1990, the company shut down operations but eight out of nine samples still exceeded the monthly objective, many by a large margin similar to previous years as given in Table 2. Microscopic analysis showed that the samples usually contained mostly foundry materials, carbon, silica and iron oxide. It is not clear why the dustfall readings did not register improvement in 1990, but the levels have reduced to acceptable levels in 1991 and the monitoring has been terminated.

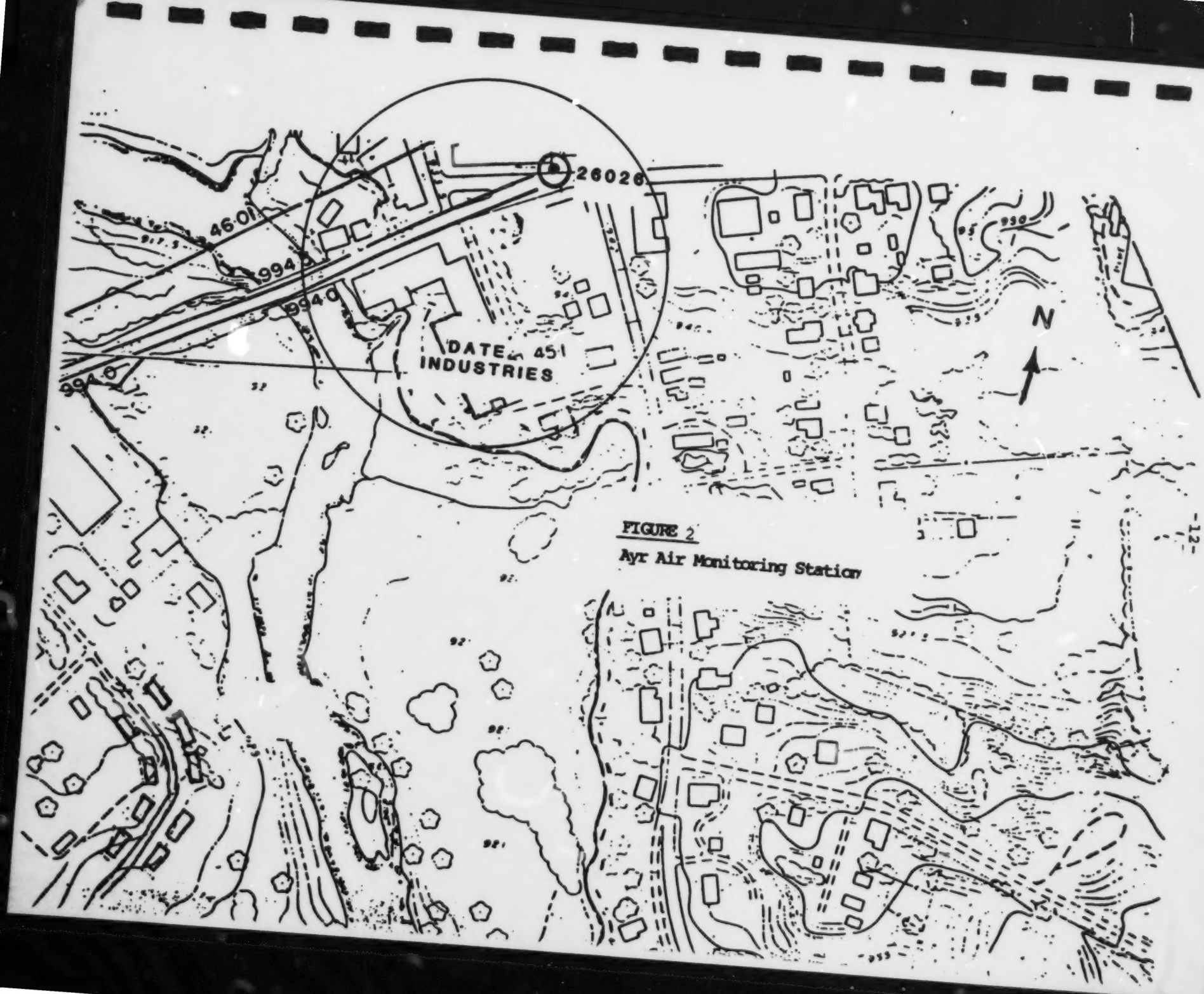


FIGURE 2

Ayr Air Monitoring Station

TABLE 2

SUMMARY STATISTICS - AYR
PARTICULATES NEAR DATE INDUSTRIES

DUSTFALL - grams/square metre/30 days

ONT. OBJECTIVES : 7.0 (1 MONTH)
4.5 (ANNUAL AVERAGE)

STATION	ANNUAL AVERAGE			1990 MAXIMUM	NO. MONTHS OVER OBJECTIVE		
	1988	1989	1990	1 MONTH	1988	1989	1990
26026 - STANLEY/SWAN	13.8	15.4	10.9	20.4	12	10	8

Brantford

Following complaints of dust fallout, dustfall sampling was conducted at two stations (one a control location) near the MacLean Foundry on Colborne Street (Figure 3). The monitoring actually commenced in late 1988 at Stations 21025 and 21026 (Table 3).

In the over two years of sampling, only one reading exceeded the monthly objective and yearly averages were below the annual objective. There was also no difference between the control location 21026 and the main monitor 21025. Consequently, in 1991, the monitoring was terminated.

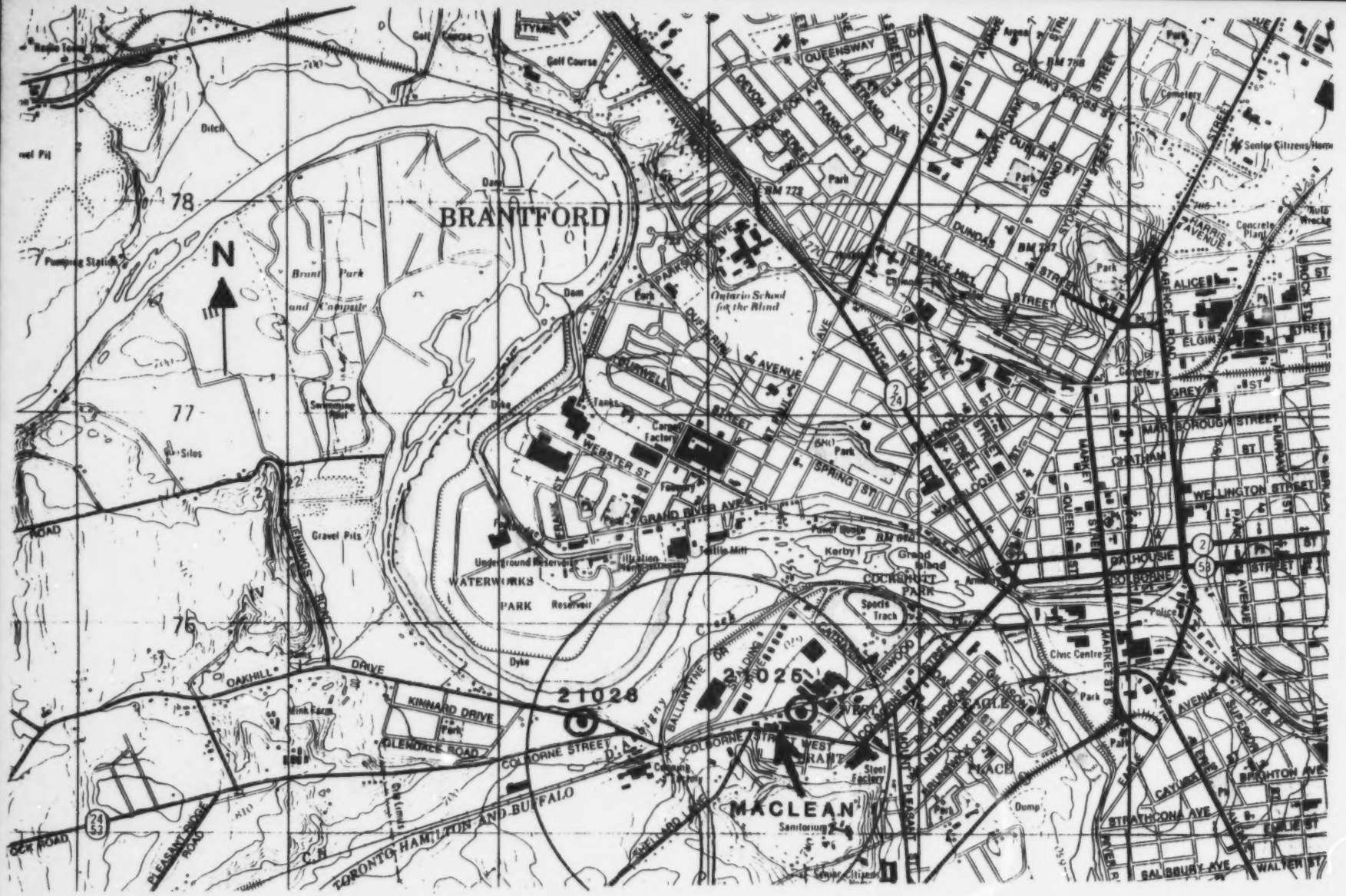


FIGURE 3

BRANTFORD AIR MONITORS

TABLE 3

SUMMARY STATISTICS - BRANTFORD
PARTICULATES NEAR MACLEAN FOUNDARY

DUSTFALL - grams/square metre/30 days

ONT. OBJECTIVES : 7.0 (1 MONTH)
4.5 (ANNUAL AVERAGE)

STATION	ANNUAL AVERAGE 1988	1989	1990	1990 MAXIMUM 24 HR	NO. OF MONTHS OVER OBJECTIVE 1988	1989	1990
21025 - COLBORNE/ SHERWOOD	-	2.6	3.0	10.9	0	0	1
21026 - OAKHILL/ COLBORNE	-	2.7	3.5	6.0	0	0	0

Fergus

Complaints of dust fallout from the GSW Water Products Co. prompted sampling in both 1989 and 1990. A map of stations is shown in Figure 4.

Initially, from September 1989 to January 1990, two high volume samplers to measure suspended particulates were utilized at station 28040 and 28041 and samples were specially analyzed for iron and manganese concentrations.

The suspended particulate data are summarized in Table 4 and as can be seen, low levels were measured with little discernible impact by GSW. Only one sample exceeded the daily objective at each, both on the same day; a day when GSW was not operative. The source of these readings is not clear.

The iron and manganese concentrations were all below their respective standards but data did indicate GSW to be the main contributor of these metals to the samples.

As this survey was inconclusive, further sampling was necessary, and a dustfall jar at station 28042 was installed in April 1990. Data are summarized in Table 4.

The first two samples exceeded the monthly objective, however, subsequent samples were all below, and the trend to low levels has continued into 1991.

Although the monitoring has only partially confirmed GSW to be a source of particulate, obvious environmental effects observed around the plant prompted the Ministry to have the company implement a control program.

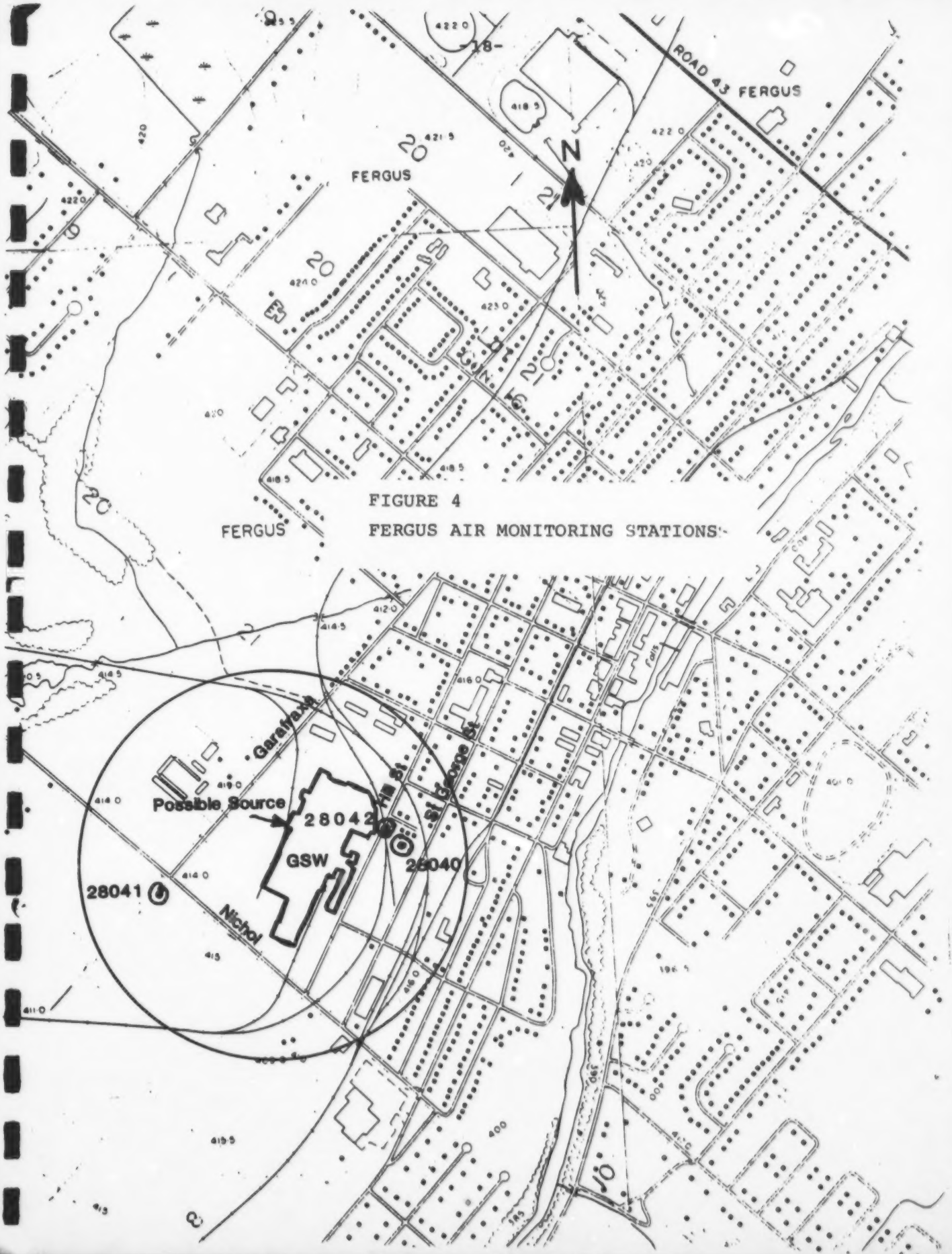


FIGURE 4

FERGUS AIR MONITORING STATIONS

TABLE 4

PARTICULATES NEAR GSW WATER PRODUCTS CO.
FERGUS

SUSPENDED PARTICULATES - micrograms per cubic metre

ONT. OBJECTIVES : 120 (24 hour)
60 (annual geo. mean)

STATION	GEOMETRIC MEAN 1989 - 1990	1990 MAX. 24 HR	NO. OF SAMPLES	NO. OF TIMES OVER OBJECTIVE 24 HR	1 YR
28040 - ST. GEORGE/MAPLE	18	133	38	1	0
28041 - GARAFRAXA/NICHOL	36 (4 months)	184	39	1	0

DUSTFALL - grams/square metre/30 days

ONT. OBJECTIVES : 7.0 (1 MONTH)
4.5 (ANNUAL AVERAGE)

STATION	ANNUAL AVERAGE 1990	1990 MAXIMUM 24 HR	NO. OF MONTHS OVER OBJECTIVE 1990
28042 - HILL/BREADALBANE	6.6	17.1	2

Guelph

The main station (28028) in Guelph which measures general ambient air quality is located at Exhibition Park (Figure 5). Sulphur dioxide continued to be recorded at mostly very low levels and all objectives were met (Table 5). The SO_2 trend graph in Figure 6 illustrates the low stable concentrations measured here since 1981, well below the annual objective. In 1990, all SO_2 readings fell in the Very Good range of the new AQI.

Ozone concentrations (Table 5) exceeded the hourly objective during 52 hours, all during the summer and all falling in the Moderate range of the AQI.

Ozone is a photochemical product of the chemical reaction between nitrogen oxides and certain hydrocarbons in the presence of sunlight. The highest levels all occurred during southerly winds and were largely imported from the United States. At these times levels were high throughout Southern Ontario. In recognition of the seriousness of the ozone problem, the Canadian Council of Ministers of the Environment decided in 1988 to develop a management plan for the control of volatile organic compounds (VOC) and nitrogen oxides (NOx) which generate ozone. A three phase program will be undertaken in Canada and the United States is undergoing its own program such that a target date of the year 2005 has been set to resolve the ground level ozone problem. Much concern is expressed also about ozone loss in the upper atmosphere where it is beneficial in reducing ultra-violet radiation. Control measures on chlorofluorocarbons (CFCs) are being implemented, however upper level ozone is not the focus of this report.

Soiling index, a measure of fine particles less than 10 microns in size, was also monitored at station 28028. Levels measured were well below the annual objective (Table 5a) and the daily objective was not exceeded.

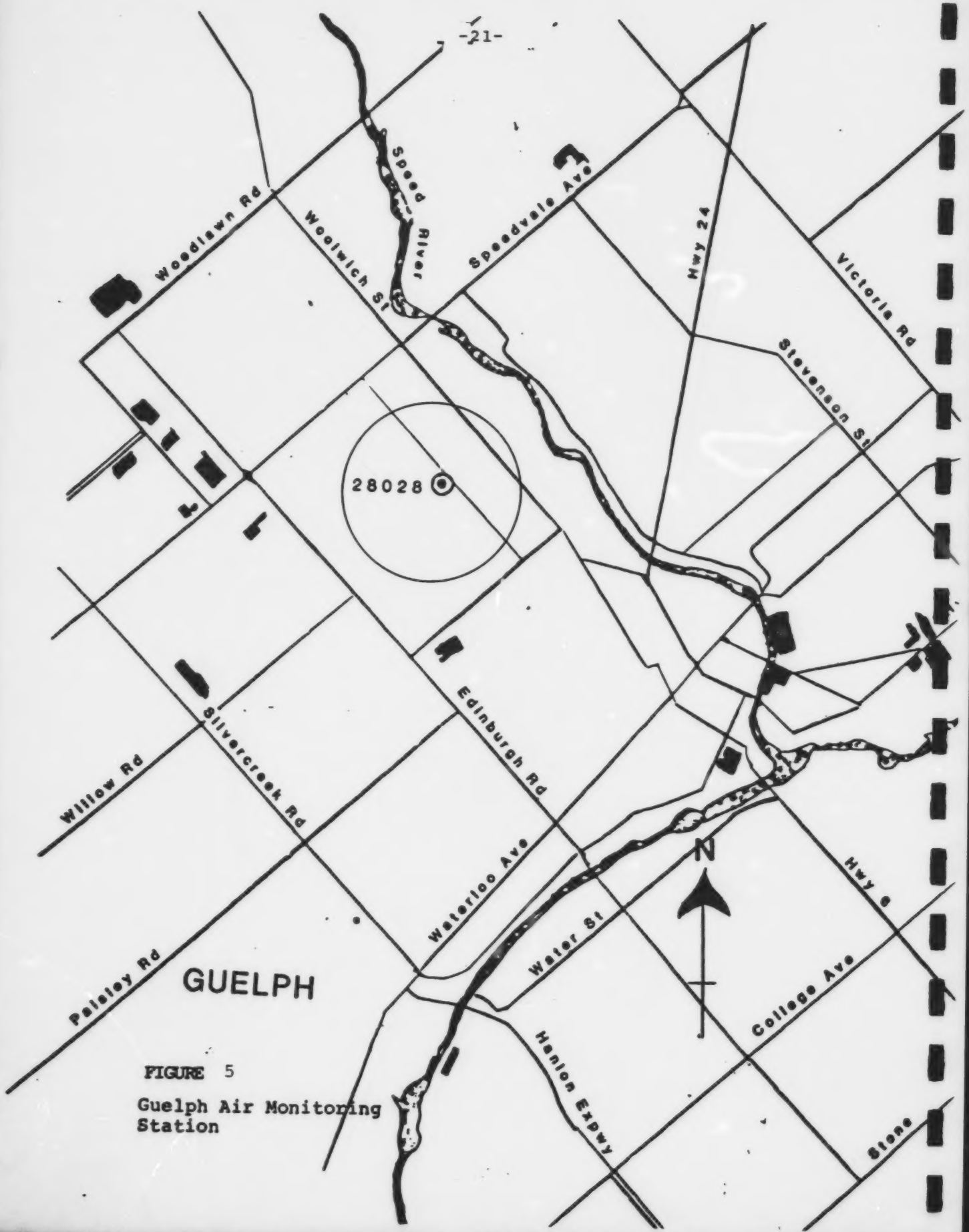


FIGURE 5

Guelph Air Monitoring Station

TABLE 5

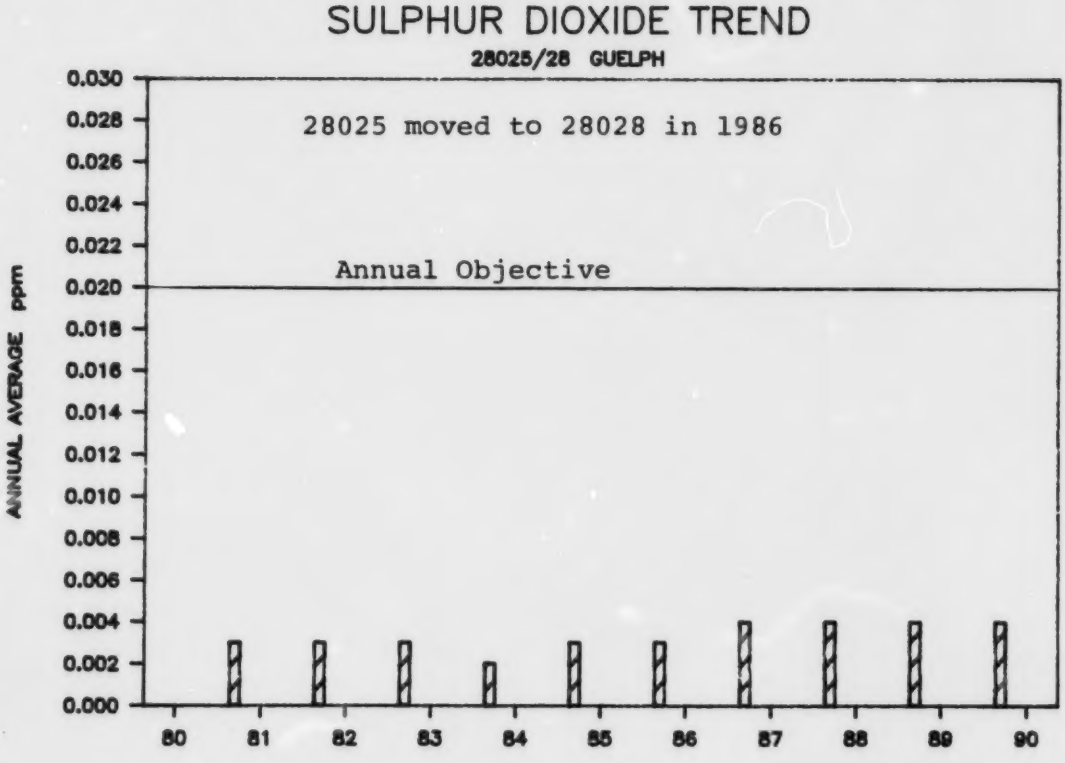
SUMMARY STATISTICS - GUELPH

CONTINUOUS POLLUTANTS - 1990

28028 - EXHIBITION/CLARK

POLLUTANT	ANNUAL AVERAGE 1988	1989	1990	MAXIMUM 1 HR	24 HR	OBJECTIVE 1 HR	24 HR	1 YR	NO. TIMES OVER OBJECTIVE 1 HR	24 HR	1 YR
SULPHUR DIOXIDE SO2 (ppm)	0.004	0.004	0.004	0.09	0.02	0.25	0.10	0.02	0	0	0
SOILING INDEX COH (COH'S)	0.20	0.21	0.22		0.7		1.0	0.5		0	0
OZONE O3 (ppb)	24.0	22.1	24.1	99		80			52		

FIGURE 6


SULPHUR DIOXIDE TREND
28025/28 GUELPH
28025 moved to 28028 in 1986
Annual Objective
ANNUAL AVERAGE ppm
0.030
0.028
0.026
0.024
0.022
0.020
0.018
0.016
0.014
0.012
0.010
0.008
0.006
0.004
0.002
0.000
80
81
82
83
84
85
86
87
88
89
90

Kitchener/Waterloo

Air monitoring in this area was initially conducted at station 26029 at Edna and Frederick Streets in Kitchener but the station was moved to 26060 - West/Homewood in June 1990. Monitoring was also conducted at station 26045 at Weber and University in Waterloo (Figure 7). The stations showed acceptable levels of sulphur dioxide meeting all criteria (Table 6). Trend graphs in Figures 8, 9 and 10 for SO_2, CO and NO_2 illustrate stable levels dating back to 1977 for the Kitchener station. All of these pollutants showed a reduction in 1990 due to the move of the station. The new site is no longer influenced by a major roadway as the old 26029 site was adjacent to the Conestoga Parkway.

The soiling index tape sampler was reactivated at the new Kitchener station and recorded low levels below all objectives similar to the Waterloo site. The monitor had previously been deactivated because Parkway traffic too heavily influencing readings, making them unrepresentative of the City in the Air Quality Index.

The resumption in this sampler also allowed for the determination of the Air Pollution Index (API) portion of the AQI.

The Kitchener station measured 35 hours above the hourly ozone objective of 80 ppb while Waterloo measured only 4 hours, all falling in the moderate range of the AQI. Trends in ozone are shown in Figure 11. Slightly higher levels tend to be found in Kitchener probably due to the Waterloo station being somewhat more affected by ozone scavenging effects by vehicle traffic.

Ozone is a photochemical product of long range transport of precursor pollutants (hydrocarbons and oxides of nitrogen) largely from the United States.

As mentioned earlier, a NOx/VOC control program in Canada and the United States is being implemented in a three phase approach with the goal of resolving the ground level ozone problem by the year 2005.

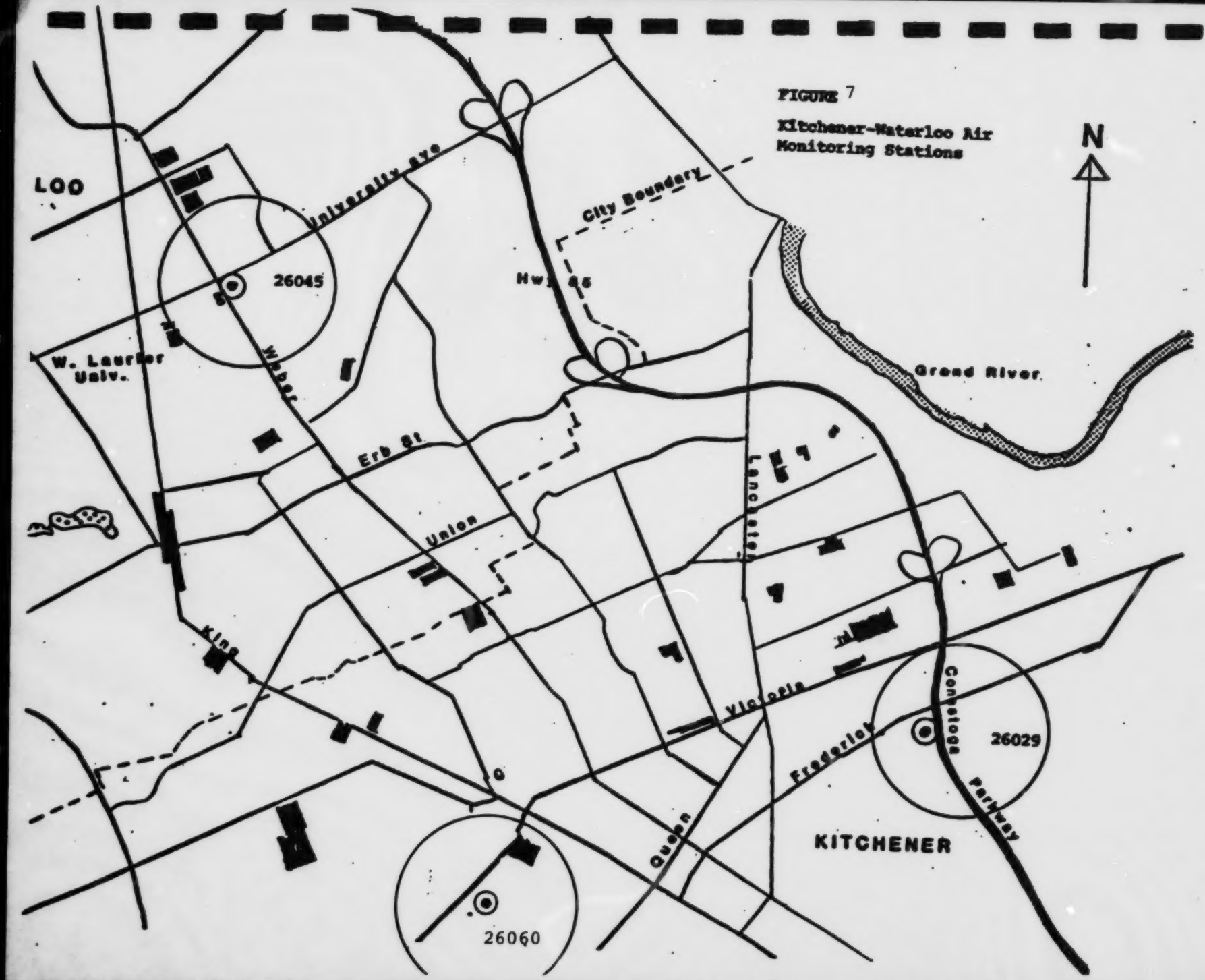


FIGURE 7

Kitchener-Waterloo Air Monitoring Stations

TABLE 6

SUMMARY STATISTICS

CONTINUOUS POLLUTANTS - 1990

26029 - EDNA/FREDERICK, KITCHENER and
26060 - WEST/HOMEWOOD, KITCHENER and
26045 - UNIVERSITY/WEBER, WATERLOO

POLLUTANT	STATION	ANNUAL AVERAGE 1988	1989	1990	MAXIMUM 1 HR	8 HR	24 HR	OBJECTIVE 1 HR	8 HR	24 HR	1 YR	NO. TIMES OVER OBJECTIVE 1 HR	8 HR	24 HR	1 YR
SULPHUR DIOXIDE SO2 (ppm)	26029/60	0.005	0.003	0.003	0.04		0.02	0.25		0.10	0.02	0		0	0
	26045	#0.009	0.006	0.002	0.04		0.02					0		0	0
SOILING INDEX COH (COH'S)	26060			+0.25			1.0			1.0	0.5			0	0
	26045	#0.20	0.23	0.20			0.9							0	0
CARBON MONOXIDE CO (ppm)	26029/60	0.9	1.1	0.7	6	6		30	13			0	0		
NITROGEN DIOXIDE NO2 (ppm)	26029/60	0.027	0.026	0.018	0.08		0.06	0.20		0.10		0		0	
OZONE O3 (ppb)	26029/60	21.6	19.9	22.4	87			80				38			
	26045	#22.0	21.4	19.7	84							4			

+ 7 months of data. Started in June 1990.

7 months of data. Started in June 1988.

Station 26029 was moved to 26060 in June 1990.

SULPHUR DIOXIDE TREND

KITCHENER/WATERLOO

26029 moved to 26060 in 1990 (both graphs)

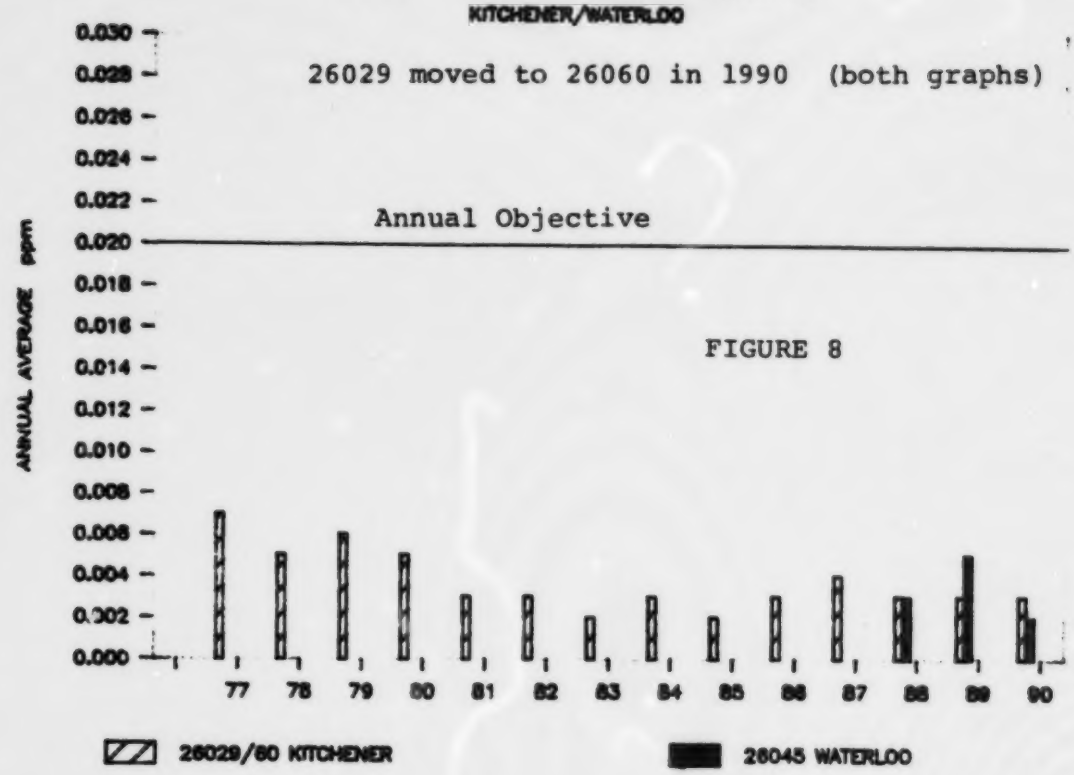


FIGURE 8

CARBON MONOXIDE TREND

26029/60 KITCHENER

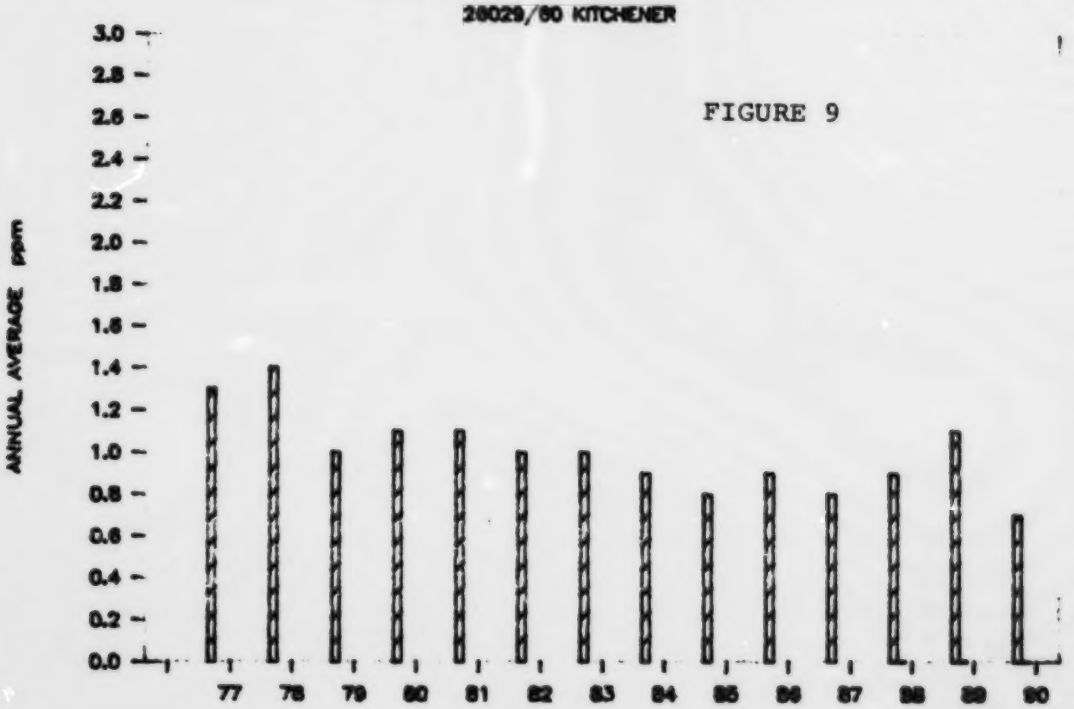


FIGURE 9

NITROGEN DIOXIDE TREND

26029/60 KITCHENER

26029 moved to 26060 in 1990 (both graphs)

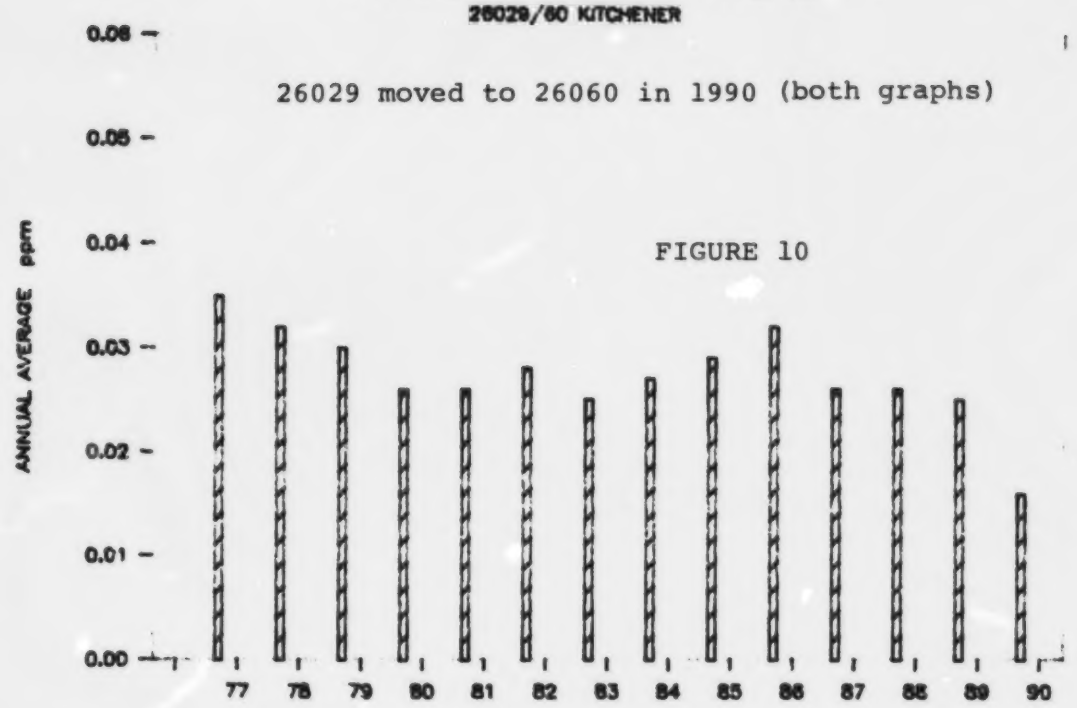


FIGURE 10

OZONE EXCEEDENCE TREND

KITCHENER/WATERLOO

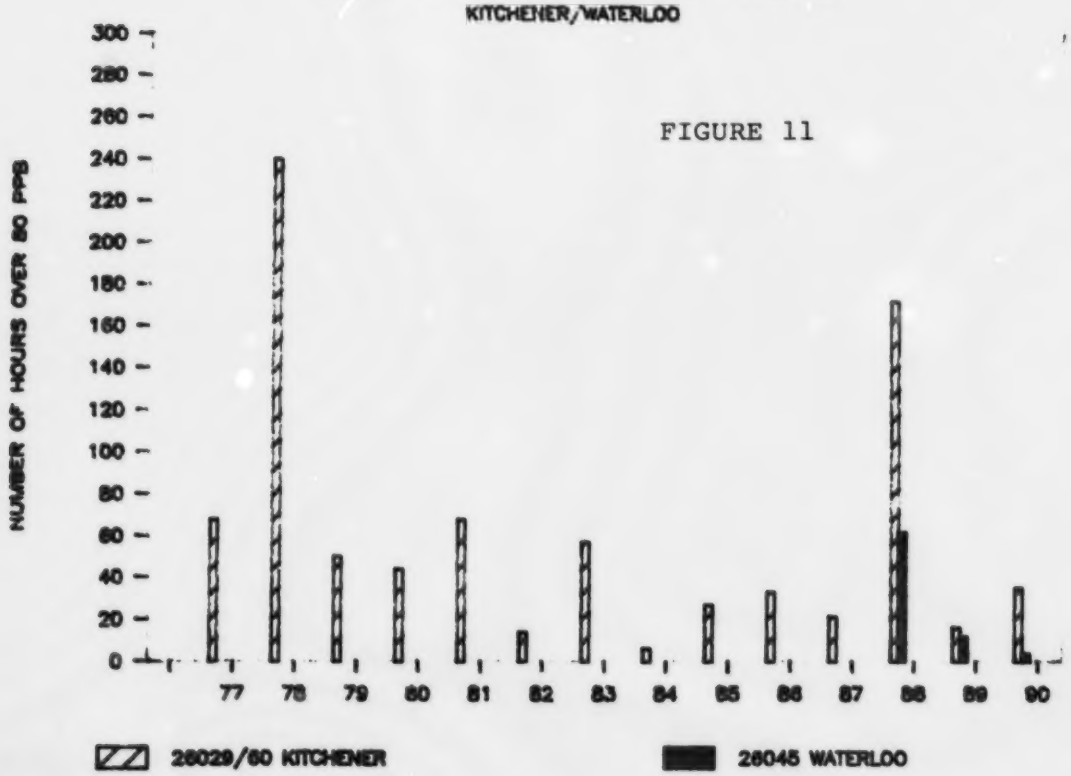


FIGURE 11

SUMMARY

This report has summarized the results of ongoing air monitoring in the Brant, Waterloo and Wellington areas. Where local industrial air pollution problems have been identified, the sources involved have already begun or completed abatement programs to reduce their emissions.

General air quality as characterized by stations in Guelph, Kitchener and Waterloo was very good, with the exception of ozone episodes during the summer, which were common to the rest of Southern Ontario.

In 1988, a new air quality telemetry system was installed throughout the Province. This new system permits all of the Ministry's stations with continuous analyzers to send data directly to a central computer facility in Toronto allowing for data availability on a real-time basis. The new system allows for immediate access to data in Hamilton and in Toronto, and also allows for remote control and maintenance of the instruments. All of this results in a more efficient monitoring program.

The main purpose of the new telemetry system is to facilitate the Air Quality Index (AQI). The AQI is a function of six different pollutants, which form up to eight separate subindices. Concentrations of sulphur dioxide, soiling index, carbon monoxide, nitrogen dioxide, total reduced sulphur and ozone are all individually converted to a common scale of index numbers with the same advisory or alert levels as the previous API i.e., 32, 50, 75 and 100. Not all stations measure all of the parameters, but the highest hourly subindex is reported several times daily to the public. The pollutant measured by this subindex may also be identified. The intent of the new index is to better inform the people of Ontario of air quality in their local area.